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TEST OF CATERPILLAR, 50,000-POUND-CAPACITY, ROUGH-TERRAIN CONTA--ETC(U)
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REPORT 2283

TEST OF CATERPILLAR, 50,000-POUND-CAPACITY ROUGH-TERRAIN CONTAINER HANDLER (RTCH)

by
Ashok S. Patil
George C. Manthey

September 1979

U.S. ARMY MOBILITY EQUIPMENT
RESEARCH AND DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA

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The tests were conducted to determine the Caterpillar, 50,000-lb, Rough-Terrain Container Handler (RTCH) characteristics to enable MERADCOM to compare what is available on the commercial market and with the requirements as specified in MIL-T-52843/GEN. The report describes the physical characteristics and the following tests: high speed, load placement, steering, service brake, travel speeds, drift, lifting and lowering speed, gradeability, static stability, dynamic stability, and noise level.

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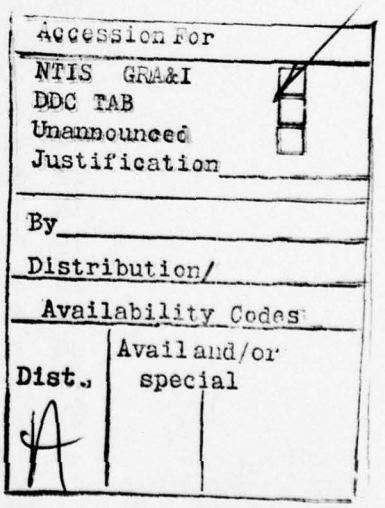
PREFACE

This investigation was conducted by the Mechanical Equipment Engineering Division, Mechanical and Construction Equipment Laboratory, US Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, Virginia. The tests covered by this report were performed by MERADCOM personnel at the MERADCOM Testing Area (MTA) from February through May 1978.

The test objective was to determine the Caterpillar, 50,000-lb, Rough-Terrain Container Handler (RTCH) characteristics and compare with the technical performance requirements as specified in MIL-T-52843/GEN.

This report describes the physical characteristics of the RTCH and the following tests: high speed, load placement, steering, service brake, travel speeds, drift, lifting and lowering speed, gradeability, static stability, dynamic stability, and noise level.



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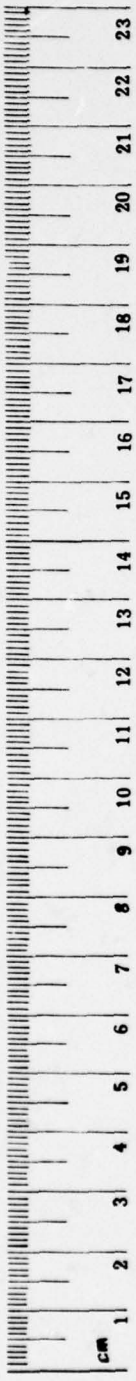
Approximate Conversions to Metric Measures

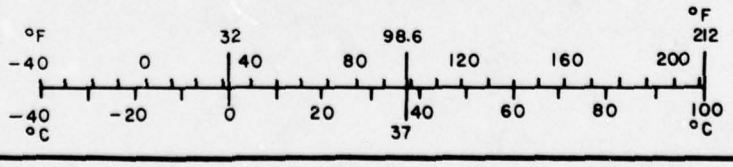
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	metric tons	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

* 1 in = 2.54 cm (exactly)



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10 000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric tons (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



TEST OF CATERPILLAR, 50,000-POUND-CAPACITY, ROUGH-TERRAIN CONTAINER HANDLER (RTCH)

I. INTRODUCTION

1. **Background.** The Caterpillar Tractor Company was awarded a rental contract to deliver a 50,000-lb, Rough-Terrain Container Handler (RTCH) under Contract DAAK70-77-C-0090, dated 25 January 1977.

2. **Scope.** This report describes the tests that were conducted at MTA from February 1978 to May 1978 on the Caterpillar, 50,000-lb, Rough-Terrain Container Handler. Tests were performed to establish baseline engineering data for a performance specification for future procurement of the 50,000-lb RTCH.

3. **Description of Test Item.** The Caterpillar, 50,000-lb RTCH is a modified, commercial Caterpillar 988B log loader. It is modified by the substitution of the mast assembly from a commercial Caterpillar AH60, 60,000-lb-capacity lift truck in place of the loader-lift-arm assembly. The RTCH has a diesel drive. It is powered by a V8 cylinder Caterpillar Diesel Model 3408 with 375 flywheel horsepower @ 2200 r/min. It has full power shift in four forward and four reverse speeds. The test item has an articulated steering feature and a 150-in. wheelbase. The basic features are designed to provide 144-in. lift height from ground to bottom of a 20/40-ft container on a fixed mast. This rough-terrain container handler is equipped to stack two high either 20-ft or 40-ft containers having a height of up to 9 ft and also to engage or disengage an 8-ft-high container resting 1 ft below ground level.

4. **Objective.** The objective of these tests is to obtain, within the limited duration of testing, the physical and performance characteristics of the test item and to enable MERADCOM to compare what is available on the commercial market with the Army's requirements.

II. TESTS AND RESULTS

5. **Preoperational Inspection and Physical Characteristics.** The objective was to determine the physical characteristics of the 50,000-lb, rough-terrain container handler and to insure that the test item was in proper condition for test operation. The test item (Figure 1) was subjected to preoperational inspection and was serviced as required. Data on pertinent physical characteristics of the test item were obtained with accurate measuring devices and clinometers where required.

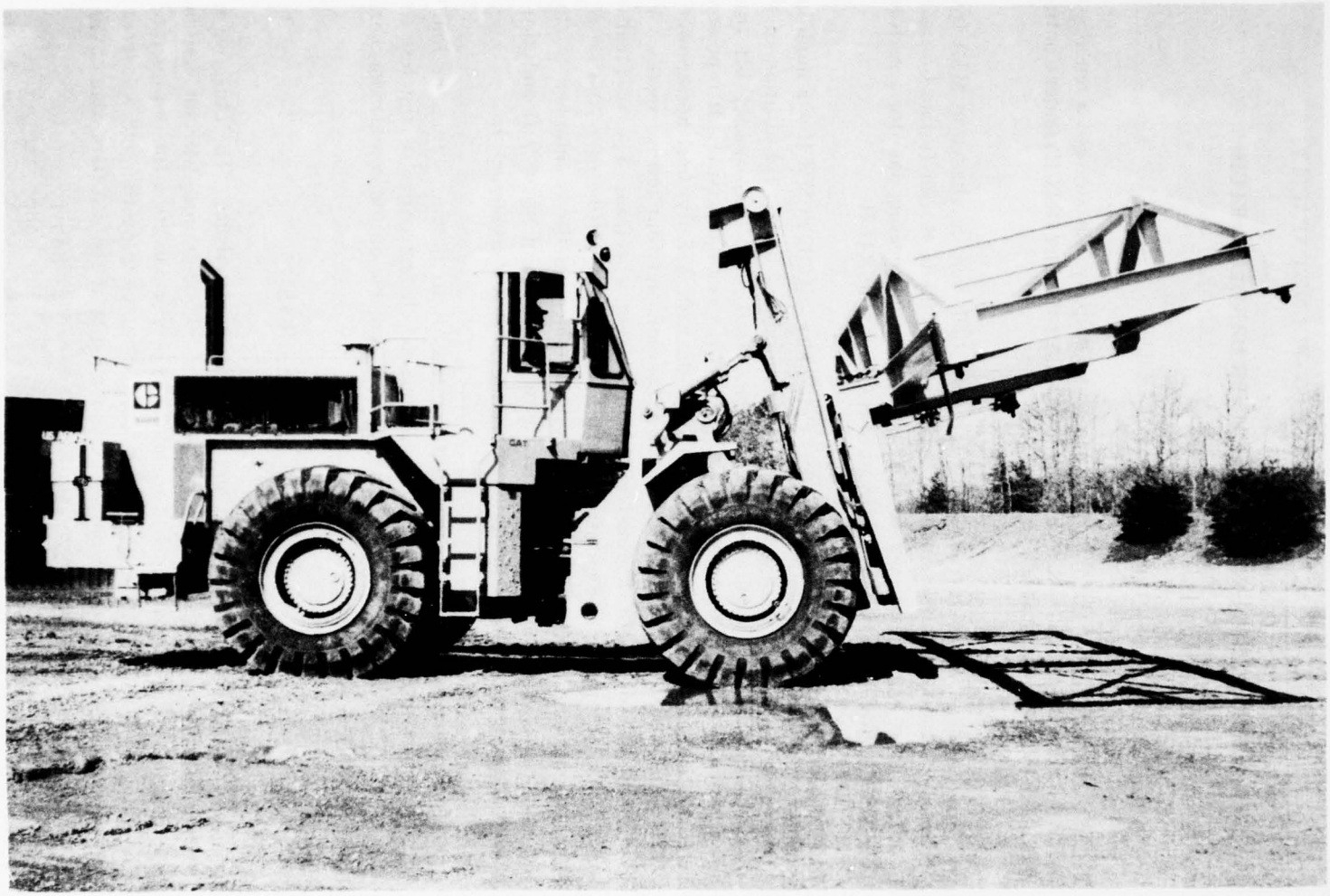


Figure 1. The 50,000-pound-capacity, rough-terrain container handler.

Physical characteristics and data of the test item are presented in the Appendix. The test item was shipped disassembled on four commercial truck trailers from the manufacturer's plant to the MTA.

6. **Tophandler Operations.** The objective was to determine the maximum sideshift oscillation and reach.

The reach was first determined to be 10.2 in. on an 8-ft platform. The links connecting the tophandler to the mast were then increased to six. With six links, the reach at a 31-in. height, i.e., simulating loading a railroad flatbed, was 18.5 in. With a platform height of 8 ft, i.e., simulating stacking MILVAN containers, the reach was 17.1 in. with the mast vertical and 18.7 in. with the mast in the forward position.

The distances for left and right sideshift were equal. Total shideshift is 24.5 in. (12.25 in. left and 12.25 in. right).

With the container sideshifted left, it was oscillated clockwise 6 degrees and counterclockwise 7 degrees from the horizontal. With the container sideshifted right, it was oscillated clockwise and counterclockwise for 9 degrees and 4 degrees respectively.

7. ***Lift Height, Low-Engagement Height, Weight, and Dimensions.*** The objectives were to determine the maximum lift height, low-engagement height, weights, and dimensions.

The lift height is defined as the vertical distance from the surface on which the truck is positioned to the bottom surface of the container. It was measured to be 147 in. The collapsed mast height, which is defined as the vertical distance from the ground surface to the uppermost projection of the upright assembly, was 183.1 in. The vertical distance from the surface on which the truck is positioned to the bottom surface of the container in the lowest position is the low-engagement height. This was found to be 12.5 in. below ground level. The distance between the farthest points on the two sides of the truck, i.e., the width, was 138 in. Table 1 shows the vehicle weights.

Table 1. Vehicle Weights

Condition	Axle Weight (lb)		Truck Weight (lb)
	Front	Rear	
Loaded*	145820	23760	168040
Unloaded	61980	57040	118040

* Load: 55,040 lb.

8. **Upright Tilt and Tilt Speed.** The objective of this test was to determine upright tilt angle and the rate of tilt.

As required in the specification, the tophandler was raised 10 feet above the surface and the mast was tilted as far forward as possible and then the mast was tilted as far rearward as possible. Angles of tilt were measured to be 5 degrees and 15 degrees, respectively.

Times to tilt maximum forward and rearward were 6 and 6.5 s, respectively.

9. **High Speed.** The objective of the high-speed test is to determine that the truck is capable of 4 hr of high-speed operation without malfunction, damage, or permanent deformation and without exceeding specified temperature limits for the cooling system, engine oil, transmission oil, universal joints, and hydraulic system. The truck was driven over a test course for 2 hr at wide-open throttle in the highest forward gear range. The truck was then stopped and various temperatures were recorded (Table 2). After stopping for no more than 5 min, the truck was started again for 2 hr of high-speed travel.

Table 2. High-Speed-System Temperatures

Thermocouple Location	Temperature (°F)		
	Start	2 Hr	4 Hr
Radiator Inlet	91	147	156
Radiator Outlet	89	138	147
Engine Oil @ Cooler (Out)	98	153	159
Engine Oil @ Cooler (In)	55	106	113
Rear Differential	60	(lead broke)	214
Front Differential	98	169	179
Transmission	92	166	173
Engine Oil Sump	119	192	199
Hydraulic Tank	71	135	143
Head End, Tilt Cylinder	58	64	69
Hydraulic Oil Cooler (Out)	72	115	117
Hydraulic Oil Cooler (In)	77	131	133
Ambient	53	71	71
U-Joint (Front)	cool	cool	cool
U-Joint (Rear)	cool	cool	cool

During the initial high-speed test, problems were present in the steering, and a heat buildup was noticed in the hydraulic control valve bank located in the operator's compartment. Caterpillar representatives made adjustments in the hydraulic system by changing various orifice sizes.

At the end of the test, i.e., after 4 hr, all vehicle-system temperatures were within the specified limits. At the end of the test, gear oil was noticed coming out of the front differential breather.

10. Load Placement. The objective was to determine the productivity of the test item when it was operating on a prescribed test course and to assess the reliability of the test item. The load-placement course consisted of three stations located on a 100-ft-radius circle. Two stations were 8-ft-high containers and the third was ground level. The test consisted of operating the truck from station 1 to station 2 with a container, depositing the container at station 2, traveling unloaded to station 3, engaging a container at station 3, traveling with the loaded container to station 1, depositing the container at station 1, etc.

The test item was operated with 40-ft containers for a total of 95.71 hr at an average cycle rate of 4.16 cycles/hr.

During the 95.71 hr of load-placement operation, the following major failures occurred:

a. Hydraulic oil became excessively hot causing hard spots in steering.

b. Cracks on outer mast were noticed.

c. Twist locks on the tophandler jammed, i.e., the control arm parallel to the outside of the top handler moved past the center position.

d. The bolts connecting the mast to the truck loosened. During assembly these bolts were unaccessible with a torque wrench.

e. Guide arms on the top handler broke off.

f. Teflon bearing on the left side of the carriage wore off.

g. When the pressure in the hydraulic reservoir exceeded 16 $lbf/in^2 g$, the backup alarm sounded. However, the relief valve on the hydraulic tank was set at 21 $lbf/in^2 g$.

11. Tire-Contact Area, Ground Pressures. The objective was to determine tire contact and then to calculate ground pressures (lbf/in^2) for different configurations.

The data are presented in Table 3.

Table 3. Tire-Contact Area, Ground Pressures

Configuration	Tire-Contact Area (in^2)				Ground Pressure (lbf/in^2)	
	Right Front	Right Rear	Left Front	Left Rear	Front Axle	Rear Axle
w/cab; w/o mast counterweights	331	540	398	572	32	41
w/40-ft container @ 49,960 lb	916	367	929	371	78	33
w/20-ft container @ 50,060 lb	972	410	791	324	77	36
w/o load and tophandler	474	678	414	644	49	49

Note: Tire Pressure: 85 lbf/in^2 front; 50 lbf/in^2 rear.

12. Axle Loads. The objective was to determine front and rear axle loads for different configurations. The data is presented in Table 4.

13. Rear-Axle Oscillation. The objective was to determine the rear-axle oscillation angle. The procedure was to raise the truck to a sufficient height by backing on a ramp (one wheel) until the axle stop was engaged. The angle, measured with a clinometer, was 12.5 degrees for both left and right.

14. Steering. The objective was to determine the steering performance on a designated obstacle course. The course was setup with stakes at two times the curb clearance circle (2 x 73.25 = 146.5 ft). The test item was driven forward at maximum speed (20 mi/h) with no load and then it was driven at 9 mi/h in reverse with rated load of 50,000 lb. There were no difficulties in either case.

Table 4. Axle Loads

Mast Position	Axle	Articulated Left (lb)	Straight (lb)	Articulated Right (lb)
Empty – Total – 118,040 lb				
Vertical	Front	61,960	61,980	62,120
	Rear	59,520	57,040	56,400
Back	Front	69,220	69,380	69,580
	Rear	59,240	59,620	59,060
Loaded – Total – 168,040 lb, w/40-ft attachment				
Vertical	Front	147,060	145,820	147,060
	Rear	21,540	23,760	22,160
Back	Front	143,820	143,180	143,920
	Rear	24,460	26,500	25,040
Loaded – w/20-ft attachment				
Vertical	Front	–	136,600	–
	Rear	–	26,200	–
w/o Load &	Front	–	43,880	–
Tophandler	Rear	–	64,940	–
Vertical				

15. Service Brakes. The objective was to determine brake characteristics. The service-brake test was conducted at 9 mi/h on a dry, 1% grade, concrete surface using a fifth wheel and a calibrated stopmeter. The initial test results indicated an average stopping distance of 12.19 ft in the forward direction and 12.36 ft in the reverse direction. However, the right rear wheels raised 6 to 8 in. off the ground during the test in the forward direction. The test results are presented in Tables 5 and 6.

A modification was made by Caterpillar personnel in the brake line to increase the stopping distance and, in turn, to keep the rear wheels on the ground during braking. however, the right rear wheel still raised 2 in. The test data are presented in Table 7.

16. Travel Speeds. The objective was to determine the maximum forward and reverse speeds with and without payload. The test item was operated on a dry, level concrete road of sufficient length to attain maximum, constant speed prior to entering the measured distance. The average, maximum forward speeds were 14.84 mi/h with load and 17.32 mi/h with no load. The average, maximum reverse speed

was 15.48 mi/h with load and 17.94 mi/h with no load. Details are in Table 8. Due to poor visibility while the test item was traveling in the forward direction in the loaded configuration, it was considered unsafe to drive at maximum speed in gears other than 1st gear in the forward direction and 2nd gear in the reverse direction.

Table 5. Service Brake Test, 20-ft MILVAN @ 49,960 lb

Load – 20-ft MILVAN @ 49,960 lb			
Slope Direction 1% Grade	Vehicle Direction	Stopping Distance (ft)	Comments
Down	Forward*	11.81	Right rear wheel raised from track.
		11.48	
		11.81	Right rear wheel raised from track.
		12.15	
Up	Forward	12.49	
		12.49	
		13.16	
		12.15	
Down	Reverse**	12.83	
		14.85	
		14.18	
		14.18	
Up	Reverse	10.46	
		10.13	
		10.80	
		11.48	

* Average forward stopping distance = 12.19 ft.

** Average reverse stopping distance = 12.36 ft.

Table 6. Service Brake Test, 40-ft Container @ 50,040 lb

Load – 40-ft Container @ 50,040 lb		
Slope Direction 1% Grade	Vehicle Direction	Stopping Distance (ft)
Down	Forward*	9.45
		15.53
		8.44
		17.55
Up		14.85
		13.50
		15.19
		15.53
Down	Reverse**	5.06
		3.04
		9.11
		10.13
Up		10.80
		10.13
		10.13
		10.80

* Average forward stopping distance = 13.75 ft.

** Average reverse stopping distance = 8.65 ft.

Table 7. Service Brake Test, 40-ft Container @ 50,040 lb (after modification)

Load – 40-ft Container – 50,040 lb

Slope Direction 1% Grade	Vehicle Direction	Stopping Distance (ft)	Comments
Down	Forward*	11.81	Rt. rear tire off ground about 2 in.
		12.99	Rt. rear tire off ground about 2 in.
		13.50	Rt. rear tire off ground about 2 in.
		12.15	Rt. rear tire off ground about 2 in.
Up		14.51	
		13.50	
		13.50	
		13.84	
Down	Reverse**	14.51	
		14.51	
		14.31	
Up		13.16	
		12.83	
		12.15	
		10.46	

* Average forward stopping distance = 13.22 ft.

** Average reverse stopping distance = 13.13 ft.

Note: six links added in top handler. 1/8-inch orifice put in rear brake to increase the braking distance.

Table 8. Travel Speeds

Load – 20-ft Container @ 50,000 lb			
		Computed Speed (mi/h)	
		Empty	Loaded
Forward	East (up 1% grade)	16.67	14.29
		17.14	–
		17.14	–
	West (down 1% grade)	17.65	15.38
		17.65	–
		17.65	–
Reverse	East	17.14	15.38
		17.65	15.38
		17.14	–
	West	18.75	15.38
		18.75	15.79
		18.18	–

17. Controls. The objective was to determine the forces and distances required to operate control levers. The test was conducted at oil temperatures of 140°F to 180°F and with the engine operating at no-load, governed speed.

The test results are in Table 9. There was no permanent deformation when a 100-lb force was applied to the valve or directional levers in each direction.

18. Steering Control. The objective was to determine the time, the tangential force, and the number of revolutions required to turn the steering wheel from stop to stop in both directions. The test was conducted with the engine operating at low idle as well as at maximum, governed speed. The results are in Table 10.

Table 9. Controls

Valve Lever	Valve Mode	Applied Force (lb)	Distance to Actuate (in.)
Tilt	Forward	18.0	1.13
	Back	13.5	1.38
Lift	Raise	18.75	1.25
	Lower	22.0	1.50
Sideshift	Left	14.0	0.57
	Right	15.5	0.57
Oscillate	Left	13.0	0.50
	Right	13.5	0.50
Twistlocks	Lock	13.0	0.57
	Unlock	13.5	0.57
Transmission	Neutral-Forward	7.0	2.00
	Neutral-Reverse	19-20	2.25
Torque Converter	Min-Max	6-10	6.75

Table 10. Steering Control

	Stop to Stop (s)						
	Left to Right		Left to Right				
	Low	High	Low	High		Revolutions	
Trial	Idle	Idle	Idle	Idle	Force (lb)	Left to Right	Right to Left
1	6	2.5	6	2.4	3-3.5	3.5	2.8
2	6	2.2	6	2.0	3-3.5	3.3	3.0
3	6	2.0	6	2.1	3-3.5	3.5	3.1

19. Reach. The objective was to determine the maximum reach of the test item. The maximum reach on the top of an 8-ft MILVAN with mast vertical was 17.125 in. and 18.75 in. with mast forward. On the top of a 31-in.-high loading dock with mast vertical the reach was 18.5 in. These results were obtained after the tophandler was modified with six links.

20. Longitudinal Gradeability. The objective was to determine the ability of the vehicle to climb with rated-load forward up a 25% slope at a speed not less than 2 mi/h.

The test item could climb at an average of 1½ mi/h on a 25% grade. Test results are in Table 11.

Table 11. Longitudinal Gradeability

Trial	Entered Speed (mi/h)	Speed on Slope (mi/h)	Comment
1	3	3-1½	3 mi/h – 15% of the slope, 1½ mi/h for remainder
2	2	2-1½	2 mi/h – 10% of the slope 1½ mi/h – remainder of slope
3	3	3-1½	3 mi/h – 20% of slope 1½ mi/h – remainder of slope

21. Dynamic Stability. The objective was to determine the dynamic stability of the vehicle during travel and braking on 15% and 25% slopes. The test consisted of driving the test vehicle with a 50,000-lb load to extreme left and right and performing a complete circle on the 15% slope. In addition, the test consisted of driving the truck forward down the 25% slope until a speed of 2 mi/h was attained, then stopping and holding the truck for not less than 1 minute. The load was lowered to ground level, the truck was backed away from the load, and the truck was stopped. The parking brake was applied and the force required to apply the brake was measured, then the test was repeated with the truck facing forward uphill.

Emergency brake operation was performed with the 50,000-lb load in carry position at the top facing rearward down the 25% slope and allowing the truck to roll with engine off until it attained 2 mi/h. All tests were performed adequately with

no apparent difficulties. The force required to apply the hand brake was negligible. During the emergency brake operation, with the engine shut off, the truck's air system was capable of performing six stops.

22. **Driveline Stall.** The objective was to determine whether the torque converter and the transmission will be able to absorb maximum stall operation without damage or permanent deformation and without exceeding the fluid temperature limit of 250°F. A thermocouple was installed at the outlet end of the torque converter to measure oil temperature. The torque converter was shifted into the highest forward gear and was stalled while the engine was operating at governed speed. The initial torque converter oil temperature was recorded and the temperature was recorded again after 30 seconds. Test results are as follows:

Initial Torque Converter Oil Temperature (°F)	135
Maximum Oil Temperature (°F)	166
Engine Speed (r/min)	2100 (1050 r/min at the Tach Drive)
Ambient Temperature (°F)	54

23. **Drift.** The objective was to determine the amount of drift. The test procedure consisted of holding the rated load at maximum lift height at a hydraulic temperature of not less than 120°F at the cylinder inlet. The vertical drift, rotational drift, and tilt were recorded at different time intervals. Details of test results are in Table 12.

24. **Underclearance, Angles of Approach and Departure.** The objective was to determine the clearance under the truck and angles of approach and departure. The dimensions and angles are shown in Figure 2.

25. **Lifting Speed – Lowering Speed.** The objective was to determine lifting and lowering speeds with and without load.

The maximum, average lifting speed with load is 33.91 ft/min. The average lowering speed is 42.01 ft/min with load, 25.48 ft/min without load, full-open valve, engine at low idle.

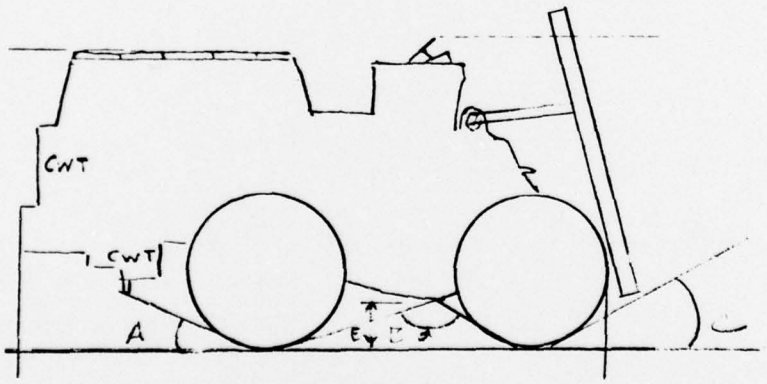
Table 12. Drift

Time (min)	Hydraulic Oil Temp (°F)	Vertical Drift (in.)[a]	Rotational Drift (deg)[b]	Tilt Drift (in.)[c]
0	148	0	0	0
2	141	0	0	0.75
5	134	0.5	0.5 Right	1.38
10	131	1.5	1.0 Right	2.5
15	131	2.38	1.5 Right	3.5
20	128	3.0	No change	4.25

[a] Vertical Drift – measurement taken from a reference mark on the lift cylinder.

[b] Rotational Drift – measurement taken from the bottom of the MILVAN container.

[c] Tilt Drift – measurement taken at the left tilt cylinder, rod end. The readings represent the change in length of the cylinder rod from the initial length.



A = 50° · B = 150°; C = 21°; E = 17 in.

Figure 2. Underclearance, angles of approach and departure.

26. Noise Levels. The objective was to determine the noise levels of the test item. The test procedure consisted of making noise-level measurements at the operator's station and exterior spectator positions.

A dosimeter, with a 3-dB exchange rate, was installed at the operator's station and located 6 in. from operator's right ear for a period of 1 hour. This test was conducted with open and closed windows and with the ventilating fans operating.

The dB(a) levels were taken on each side and at the rear of the vehicle at 5, 25, and 50 ft while the container handler was operating under simulated work conditions. See Figure 3 for microphone positions.

The passby test was conducted in an open area on a test track made of bank gravel. The microphone was located 50 ft from the center of the vehicle path. These noise levels were recorded on magnetic tape and were subsequently analyzed with an octave band analyzer.

The test results are presented in Tables 13 and 14.

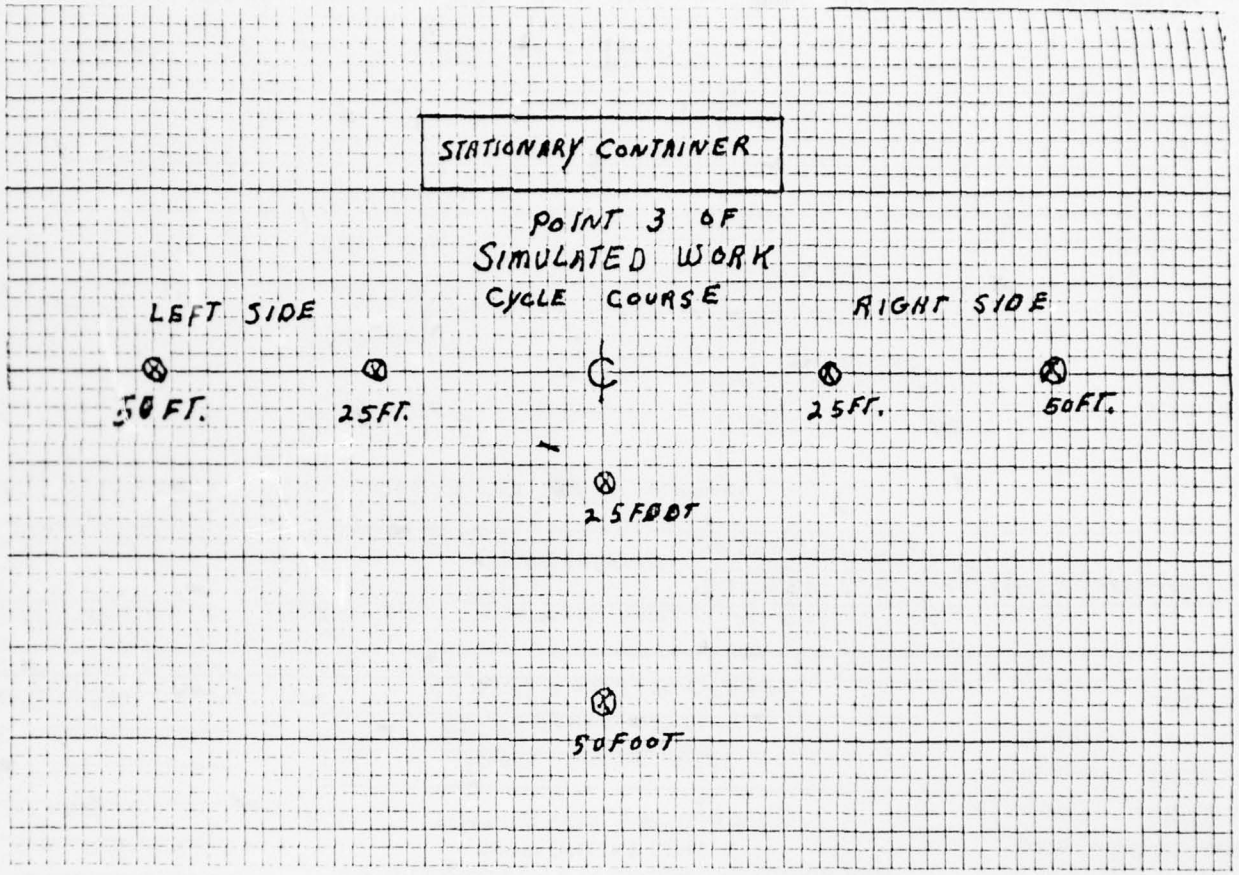


Figure 3. Micorphone locations for 50,000-lb container handler.

Table 13. Audio Noise Test – Simulated Work Cycle

ITEM: ROUGH TERRAIN CONTAINER HANDLER 50,000 LB.
MFGR. CATAPILLAR
MODEL NO. —
SERIAL NO. —
REF: MIL-T-52921

TEST AND EVALUATION DIVISION
U. S. ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT CENTER
FORT BELVOIR, VIRGINIA 22060

AUDIO NOISE TEST
DB-A SOUND LEVELS
DB REF: 0.0002 MICROBAR

TEST NO. —
SHEET 1 OF 2
DATE 19 MAY 1976
JOB NO. 8121
RECORDER GARDNER
OBSERVER ENGLISH & MANTHEY

TEST SITE: FORK LIFT TEST AREA MERADCOM ANNEX FT. BELVOIR VA.

TYPE TEST: SIMULATED WORK CYCLE

MICROPHONE: DISTANCE: 25 & 50 FEET FROM & 5 FEET FROM PERIMETER
HEIGHT: 4 FEET

TEST AREA SURFACE CONDITION: COMPACTED BANK GRAVEL

50 FEET DB-A			25 FEET DBA			5 FEET DB-A LIFTING 40 FT. CONTAINER 50,000 LB. LOAD		DOSIMETER 3dB EXCHANGE RATE 80-130 RANGE 1 HR.
RIGHT	LOADED	84	RIGHT	LOADED	90	RIGHT SIDE	100	WINDOWS CLOSED 90
RIGHT	NO LOAD	84	RIGHT	NO LOAD	89	LEFT SIDE	99	WINDOWS OPEN 92
LEFT	LOADED	85	REAR	LOADED	89	REAR	104	DID NOT EXCEED 115 DB LEVEL EITHER CONDITION
LEFT	NO LOAD	84	REAR	NO LOAD	88			
REAR	NO LOAD	83						

NOTES: DOSIMETER G.R. mdl. 1954-9710 SER.# 500401
DOSE INDICATOR G.R. mdl. 1954 SER# 100230
SOUND LEVEL METER B+K mdl. 2209 SER# 595136 MIKE B+K mdl. 4165 SER# 399672

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2 Sep 75

Table 14. Audio Noise Test – Passby

ITEM: CONTAINER HANDLER ROUGH TERRAIN 50,000 LB.
MFGR. CATER PILLAR
MODEL NO.
SERIAL NO.
REF: MIL STD 1474 MILIT-52951

ELECTRICAL AND MECHANICAL DIVISION
U. S. ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA 22060

Audio Noise Test
Octave Band Sound Pressure Levesl
DB Ref; 0.0002 MICROBAR

TEST NO.
SHEET 2 OF 2
DATE 19 MAY 1978
JOB NO. 8121
RECORDER GARDNER
OBSERVERS ENGLISH MARTINEZ

TEST SITE: FORK LIFT TEST AREA MERADCOM ANNEX FT. BELVOIR, VA.
MICROPHONE HEIGHT: 4 FEET | TYPE TEST: PASSBY | TESTS: LOAD: 40 FOOT CONTAINER 50,000 LBS. 1ST GEAR; NO LOAD: 4TH GEAR FULL THROTTLE
DISTANCE FROM CENTER OF TEST ITEM: 50 FEET | TEST SURFACE: GRAVEL TEST TRACK

Octave Band Center Freq Hz		LOAD 1ST GEAR RIGHT SIDE	LOAD 1ST GEAR LEFT SIDE	NO LOAD 4TH GEAR RIGHT SIDE	NO LOAD 4TH GEAR LEFT SIDE
	AMB.				
63	62	86	90	74	76
125	59	90	90	81	84
250	55	92.5	90	78	82
500	48	81.5	81.5	75	78
1000	46	82	81	74	78
2000	39	79	79	69	74
4000	25	74	72	66	70
8000	13	69.5	67	58.5	63.5
A-P	72	93	92	86	88
DB-A	52	86	81	78	82

WEATHER CONDITIONS	Limits
HUMIDITY	55%
TEMPERATURE	83°F
WIND	6
BAROMETER	30.05

NOTES:
Instrument List: Sound Level Meter B+K Ser. # 595136 Model # 2209 CAL. DATE 3-3-78
Octave Band Analyzer G.R. Ser # 2908 Model # 1558-BP Microphone B&K Ser # 39967 Mdl. 4165
Calibrator B+K Ser # 601389 Mdl. # 4230 TAPE RECORDER NAGRA Mdl. IV-SJ SER.# 4414

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APPENDIX

PHYSICAL CHARACTERISTICS

Truck Manufacturer: Caterpillar
Model No. and Name: 988 B
Rated Capacity: 50,000 lb at 48 in. L.C., Serial #: 50 W 1601

I. Dimensions:

Overall length including spreader or forks: 415.2 in.
Overall length to face of mast: 308.7 in.
Overall truck width without spreader: 138 in.
Overhead guard: Yes; Overhead-guard height: 161.4 in.
Tophandler lift: 147 in.; Reach below level: 12.5 in.
Clearance of rear tires with respect to truck's structure: 11 in.
Distance wheels protrude beyond body of truck: 2 in.
Wheelbase: 150 in.
Front tire tread width (C_L to C_L): 102 in.
Rear tire tread width (C_L to C_L): 102 in.
Ground clearance under truck: 17 in.
Chain displacement on rollers or guards: .25 in.
Tilt: 7.5° Forward; 13° Rearward
Side shift from center: 12¼ in. left, 12¼ in. right
Centerline of front axle to mast face: 55.5 in.
Reach of mast face to wall of 8-ft-wide container: 12 in. horizontal
Weight: Empty: 61,980 lb front; 57,040 lb rear; 118,040 lb total; with/rated load: 145,820 lb front; 23,760 lb rear; 168,040 lb total
Spreader type: fixed
Spreader length: 95.1 in. (40-ft spreader)
Spreader width: 479.1 in. (40-ft spreader)
Towing device: rear
Lifting attachments: 5; 4-in. inside diameter
Tiedown attachments: 2; 4-in. inside diameter
Exhaust muffler: Yes; Clearance between outlet and ground: 162 in.
Exhaust system protected against entry of rain: No
Angle of approach (front): 49 to 51 degrees
Angle of departure: 21 to 23 degrees
Oscillation of rear axle: 25 degrees (total)

PHYSICAL CHARACTERISTICS (CONT'D)

Seat location: center
Distance between inner edges of accelerator and brake pedal: 1 in.
Width of pedals: accelerator: 3.5 in.; brake: 7 in.; declutch: 4 in.
Distance from top of seat to underside of guard (w/operator): 44.5 in.
Distance between bars (overhead): 48 in.
Seat adjustment: Yes; 4 in. horizontal, 3 in. vertical
Clearance between seat and steering wheel in fwd position: 16.5 in.
Rearward position: 20.4 in.
Battery compartment: 26-in. length; 23-in. width; 17-in. height

II. PRIME MOVER:

Type: Diesel
Manufacturer and Model No.: Caterpillar – 4-stroke, 65° V8
Turbocharged – Model 3408 PC # 48 W 3315
Arrange # 4 N 6254

No. of cylinders: 8
Bore and stroke: 5.4 x 6 in. (catalog)
Piston displacement: 1.099 cu. in. (catalog)
Rated hp @ r/min: 375 hp @ 2200 r/min (catalog)
Oil filter: Spin-on, full-flow (bypass)
Oil cooler: Yes
Cooling: Water
Radiator construction: Fin and tube
Fan: Pusher type

IIIa. Transmission and Clutch:

Transmission Manufacturer: Caterpillar; Model: CAT – planetary
No. speeds forward: 4; reverse: 4
Transmission type: Powershift
Coupling: Torque converter
Auxiliary transmission cooling system: Water
Inching pedal travel for full disengagement: 1 in.

IV. Driveline Between Transmission and Axle:

External drive shaft: Yes

PHYSICAL CHARACTERISTICS (CONT'D)

VI. Axles:

Front Axle:
Manufacturer: Caterpillar; Model: fixed
Driven: Yes
Type reduction at wheel: Planetary
Differential lockup: None

Rear Axle:
Manufacturer: Caterpillar
Driven: Yes
Type reduction at wheel: Planetary
Steerable wheels: No

VII. Steering System:

Type: Articulated
Steering angle from C_L to left: 35 degrees; from C_L to right: 35 degrees
Power assisted: Yes; Hydraulic: Yes
Steering wheel: Yes
Steering wheel diameter: 15 in.

VIII. Braking System:

Hydraulic: Yes
Front: disc; Manufacturer: Caterpillar
Model: oil disc
Rear: disc; Manufacturer: Caterpillar
Model: oil disc
Brake adjustment: Self adjusting

IX. Parking Brake:

Location: Drive shaft
Type: Disc
Type of actuation: Lever

X. Tires:

Front: No. of axles: 2; Size: 3565R 33X; No. plys: RD2
Manufacturer: Michelin; Model: Radial Type A

Inflation pressure: 85 lbf/in^{2}g
Tread depth: Before test: 3-5/8 in.
Rolling radius at rated load: dia. – 81.5 in.; width – 35.5 in.

Rear: No. of axles: 2; Size: 3565R 33X; No. plys: RD2
Manufacturer: Michelin; Model: Radial Type A
Inflation pressure: 50 lbf/in^{2}g
Tread depth: Before test: 3-5/8 in.
Rolling radius at rated load: Free radius – 40.5 in.; loaded static radius – 36.9 in.

XI. Electrical System:

No. of batteries: 2; Series: yes
Voltage (each): 12 volts; system voltage: 24 voits

XII. Lighting System:

Forward: Driving: Yes; Flood: Yes
Rearward: Driving: Yes
Stop light: Yes
Panel light: Yes

XIII. Intake System:

Air Cleaner type: Dry type

XIV. Hydraulic Components:

Lift cylinder: Single acting
Mast configuration: Roller (no. of stages: 2)
Hydraulic filters: Yes
Oil cooler: Yes

XV. Instrumentation & Controls:

Voltmeter: Yes; full scale: 34 volts
Engine oil pressure indicator: Gauge
Normal reading at low idle: green; high idle: green
Transmission temperature gauge: Yes
Coolant temperature gauge: Yes

Fuel gauge: Yes
Hour meter: Yes
Horn: Yes
Ignition switch: Yes; Key type ignition: Yes
Starter switch: Yes
Neutral start protection: Yes
Starter disconnect: Yes
Battery discharge indicator (electric FLT's): Yes

XVI. Fluid Capacities:

Fuel tank: 165 gal.
Hydraulic reservoir: 78 gal. (catalog)
Engine crankcase: 11 gal. (catalog)
Transmission: 17.5 gal. (catalog)
Front axle: 27 gal. (catalog)
Rear axle: 27 gal. (catalog)
Radiator capacity: 28 gal.

XVII. Operator's Compartment:

Lift control: Yes; right-hand actuation: Yes
Travel from center position: 3.5 in.
Location: Near operator's seat
Tilt control: Yes; right-hand actuation: Yes
Travel from center position: 3 in.
Location: Near operator's seat
Side shift: Yes; right-hand actuation: Yes
Travel from center position: 1.5 in.
Location: Near operator's seat
Directional lever: Left-hand actuation
Location: On column
Position markings: Yes
Type: On knob; decals; diagrams
Distance between near edges of adjacent knobs: 1.2 in. minimum
Distance between rim of steering wheel and nearest projection: 6.5 in. minimum
Vertical distance between lowest point on steering wheel rim and highest point of the unoccupied seat cushion: 7 in.
Height of seat above floor board: lowest position – 18 in.

PHYSICAL CHARACTERISTICS (CONT'D)

Location of parking brake in relation to seat: Under panel below steering wheel
Distance between near edge of seat and parking brake: 11 in.
Vertical distance between fully depressed brake pedal and accelerator pedal: 3.5 in.
Projection of depressed brake pedal: 3 in. below accelerator
Instruments flush-mounted on panel: Yes
Intermediate step provided: Yes; no.: 5 – 1st is 25 in. high
Windshield wipers: Yes
Heater: Yes; Fan: Yes
No. of doors: 1; no. of windows to open: 3
Seat belts: Yes; Co-driver's seat: No.

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